Cardiothoracic Surgery

Radiology

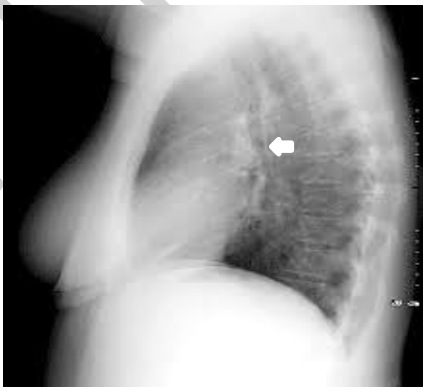
CXR 1: Normal Chest X-ray

- No dye = Plain CXR

View:

1. Posteroanterior view [PA] (mostly used)
2. Anteroposterior view [AP] (in special circumstances such as bedridden patients)
3. Lateral view (best view for mediastinum and for depth and site of mass or lesion)

- Note: White arrow is pointing to a landmark round black dot which represents Lt main bronchus.

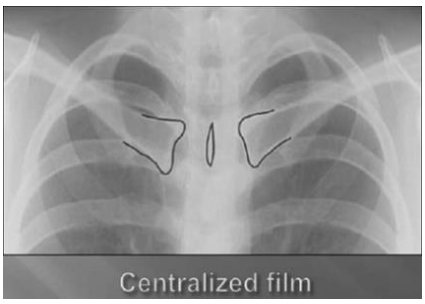


- Patient should be standing rather than supine position so that if there is any fluid it will accumulate in the costophrenic angle thus obliterating it.
- Points of consideration:

1. Orientation: Right and left

Determined by:

- Rt: trachea is normally slightly shifted to the right, liver
- Lt: aortic knuckle/knob, cardiac shadow, gastric bubble



2. Centralization: Centralized or rotated

Determined by 2 ends of the clavicles equidistant from the spine

Importance: to avoid unequal X-ray penetration on both lungs.

3. Penetration: Adequate or over penetrated or underpenetrated

Dose is based on patient's weight. How to know if it is adequate or not:

- The vertebrae must be seen JUST under the cardiac shadow.
- If vertebrae are very clear = over penetration
- If not visible = underpenetration

4. Zones: 4 zones from outside to inside

Zone 1: *Subcutaneous tissue and diaphragm*

- Subcutaneous tissue: surgical emphysema (black areas or haziness present) or any soft tissue mass
- Diaphragm: presence of air underneath it

Zone 2: *Ribs and bones (thoracic cage)*

- Check for fractures, tumour (e.g. osteoma), infection (e.g. osteomyelitis)

Zone 3: *Lungs*

- Pleura: collection of fluid or air or both, costophrenic angles
- Lung: lung markings (i.e. bronchovascular markings at mediastinum), masses, cysts

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Zone 4: *Mediastinum*

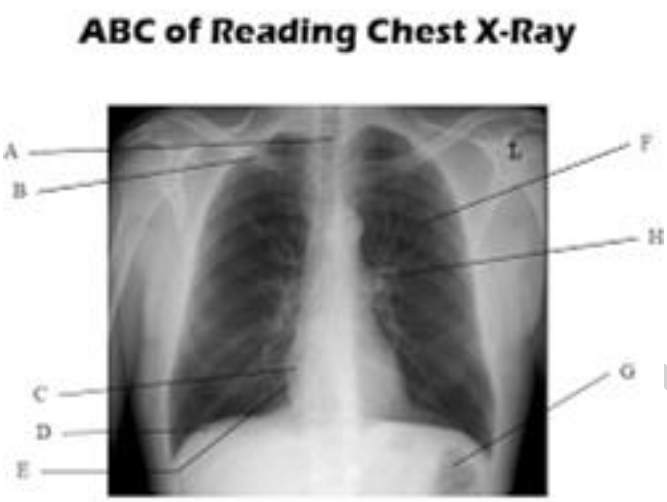
- Airway: trachea and bronchi, centralization or deviation (shifting) of trachea, aortic knuckle, mediastinum width, cardiac shadow

Lat. view is best as it shows different zones as follows:

S = Superior zone **A** = Anterior zone

M = Middle zone **P** = Posterior zone

- Alternate way of reading CXR: ABC reading as follows:



A = Airway (midline, patent)

B = Bones (fractures, lytic lesions)

C = Cardiac Silhouette size (should be less than 50%)

D = Diaphragm (flat or elevated hemidiaphragm?)

E = Edges (borders) of heart

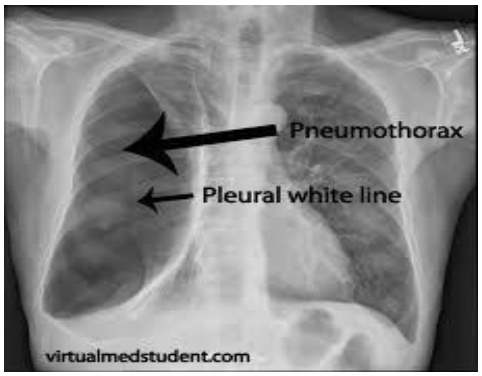
F = Fields (lung fields well inflated; no effusions, infiltrates, or nodules noted)

G = Gastric Bubble

H = Hilum (nodes, masses)

I = Instrumentation

CXR 2: Pneumothorax

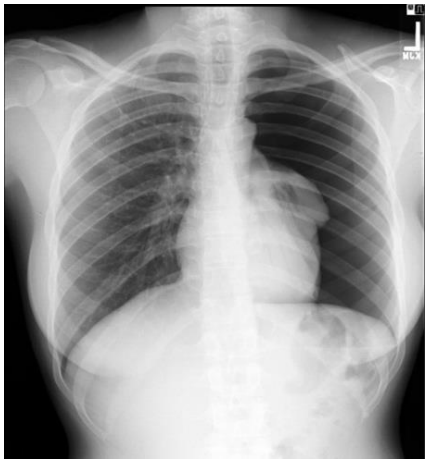


Criteria:

1. Lung reticulations are not reaching the chest wall.
2. Jet black space (due to air accumulation between chest wall and lung) with pleural white line indicating lung border.

- How to comment?

Plain CXR PA view showing total lung collapse with jet black hemithorax indicating pneumothorax.

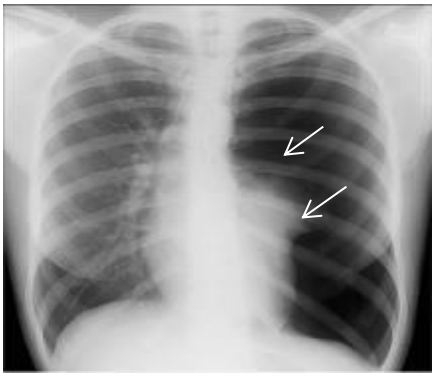


- Degrees of severity:

From the chest wall measure the following:

- 1 finger separation = mild
- 2 fingers = moderate
- > 2 fingers = massive

In massive pneumothorax, the lung is totally collapsed towards the hilum and must be mentioned whether associated with or without tension pneumothorax (shifting mediastinum = +ve tension)



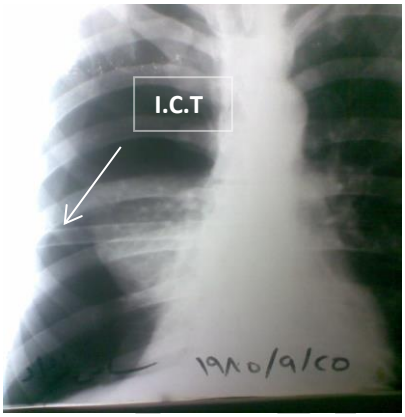
Tension pneumothorax with mediastinal shift and completely collapsed lung (lung became liver-like)

Notice Rt lung markings are very evident.

Pneumothorax and mycetoma with air-crescent (cap)

Cause:

Chronic abscess with fungal infection

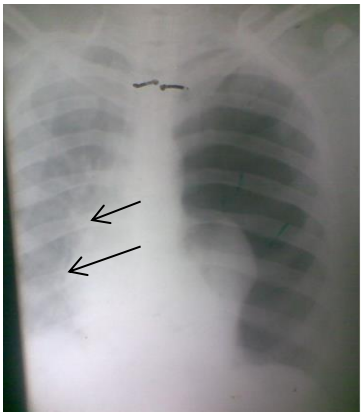


Rt pneumothorax with total lung collapse + ICT

Notice ICT in wrong position – had to be in 2nd ICS

Causes of failure of lung expansion:

1. Malpositioned ICT
2. Endobronchial obstruction with mucus plug or FB
3. Bronchopleural fistula with major air leak



Lt tension pneumothorax + total lung collapse (lung became liver-like)

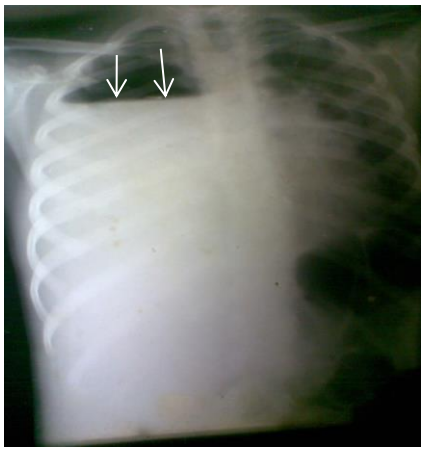
Notice the mediastinal shift indicated by the arrows.

Treatment:

Wide-bore needle to relief the tension then ICT to prevent sudden expansion of the lung.

CXR 3: Hydropneumothorax

A transverse line indicating **air-fluid level** with jet black area above this line indicating presence of both pneumothorax and fluid accumulation along with lung collapse.



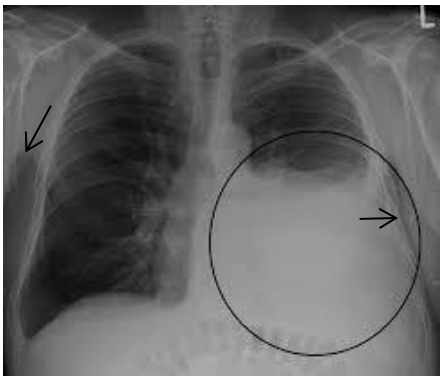
CXR 4: Pleural Effusion

Definition: Pleural space is a potential space containing normally about 50 cc of fluid.

- Most dependent part (site of fluid collection) = costophrenic angle

Degrees of severity:

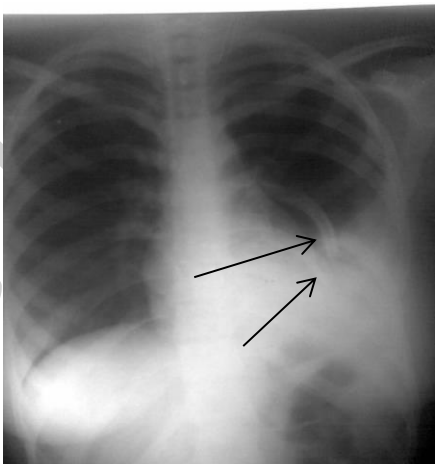
- Mild = obliterating costophrenic angle (i.e. about 200-300 cc)
- Moderate = till the hilum of the lung
- Massive = till 2nd rib up to complete hemithorax
- Effusion may be predisposed by trauma or malignancy.



Arrow pointing at black space in subcutaneous tissue indicating surgical emphysema thus main cause of this Xray is traumatic.

Differential diagnosis:

- Hydrothorax
- Haemothorax (associated with lung contusion or fracture rib(s) indicating trauma)
- Chylothorax

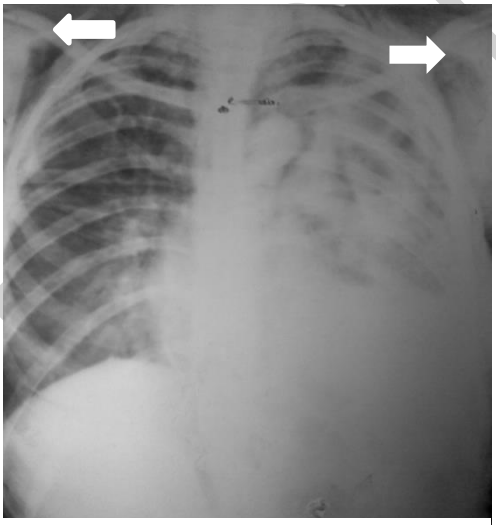


Lt rib fractures with Lt haemothorax (mild to moderate)

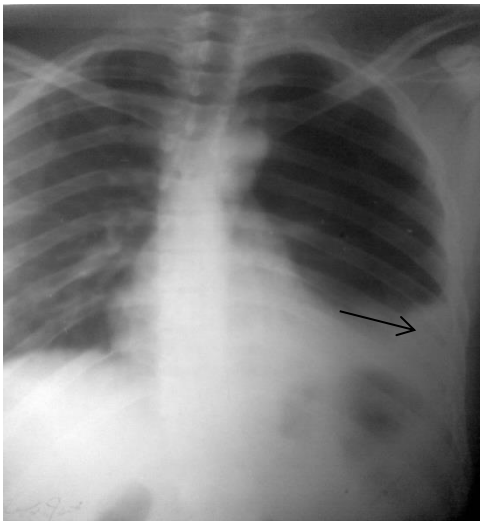
Surgical emphysema:

Appears as haziness or air in subcutaneous tissue. Causes:

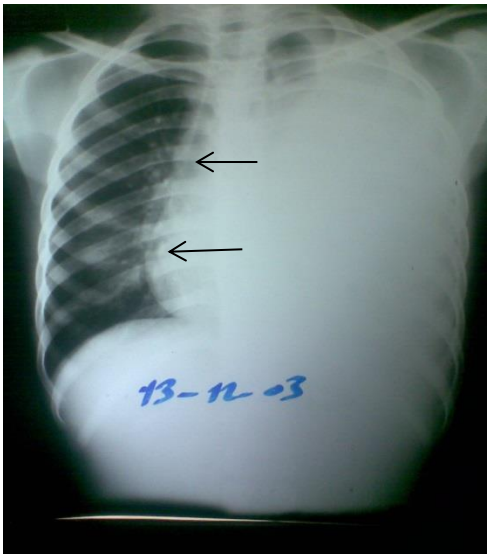
1. Lung: trauma, iatrogenic (surgical)
2. Mediastinum: oesophageal injury/perforation, tracheal injury or any mediastinal structure injury.

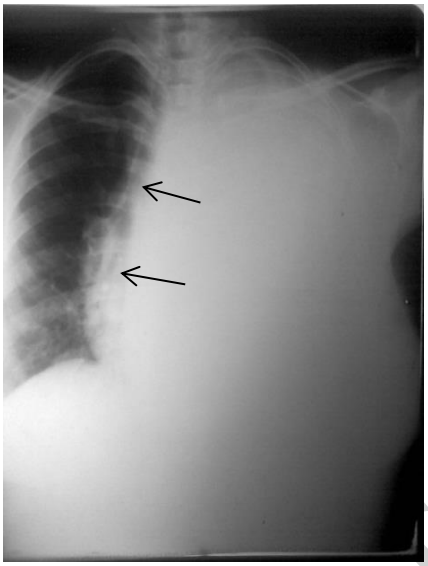


Massive surgical emphysema (arrows) + lung contusion + Lt haemothorax



Lt mild effusion (localized in fissure)

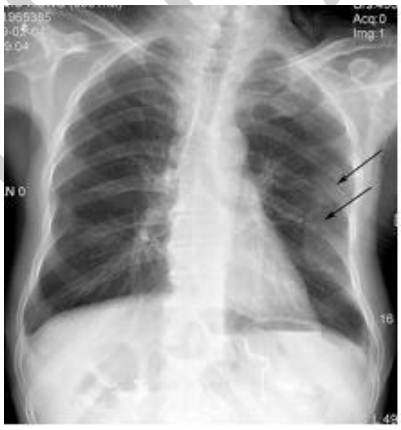




Lt massive effusion with shifting of the mediastinum

Treatment: ICTD in 5th ICS

CXR 5: Fracture Ribs



- Most important: Flail chest

Definition: At least two fractures per rib in at least THREE ribs thus producing a free segment.

- Most characteristic and diagnostic sign: Paradoxical movement of free segment (seen clinically)
- Cause: Trauma
- 3 ribs with pushed in fractured segment = Stove-in chest

CXR 6: Foreign Body [FB]

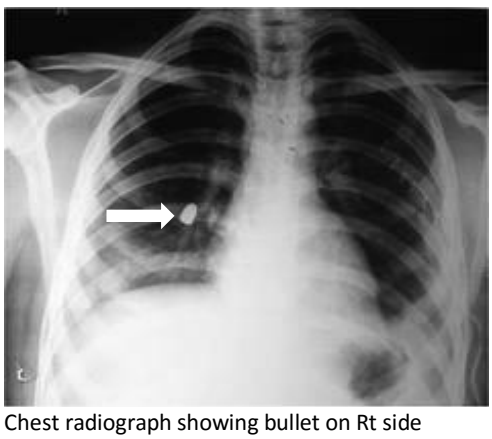
- How to differentiate between oesophageal FB and tracheal FB?

Oesophagus is most wide horizontally thus the FB appears to be very wide such as the coin in the Xray whereas the trachea is mostly wide in AP due to cartilaginous tracheal rings thus FB appears narrow and long.

- Narrowest part of the oesophagus = cricopharyngeus at C6
- Treatment: Rigid endoscopy extraction

Complications:

1. Pressure necrosis by the FB
2. Perforation
3. Abscess formation: cervical, mediastinal



Chest radiograph showing bullet on Rt side

Bullet injury:

Types of bullet injuries:

1. Non-penetrating non-perforating = tangential injury
2. Perforating: with inlet and exit
3. Penetrating: inlet only and retained inside the chest

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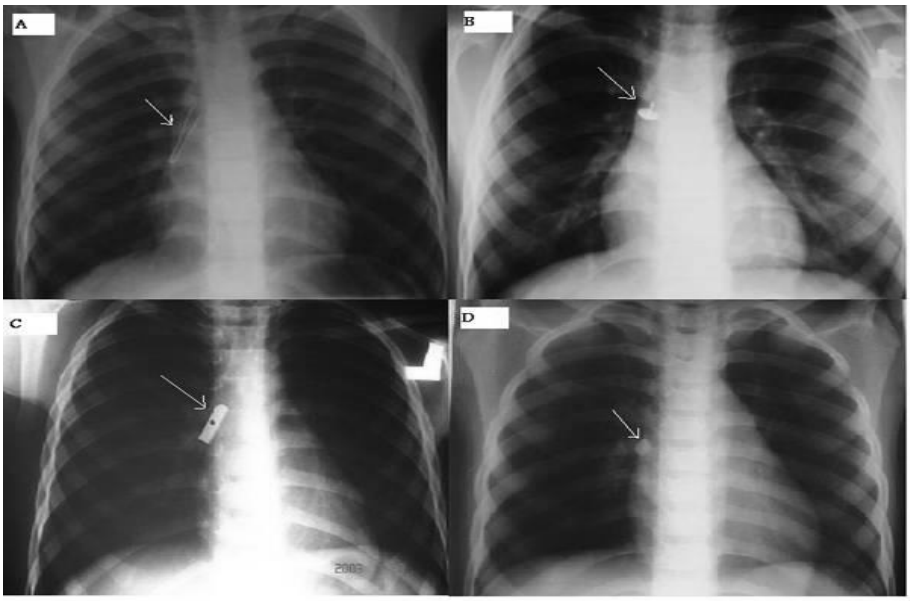


Tracheobronchial FB (inhaled FB)

A: Hair/scarf pin

B: Bulletin board pin

C: Sharpener's blade

D: Bead

Treatment/extraction method:

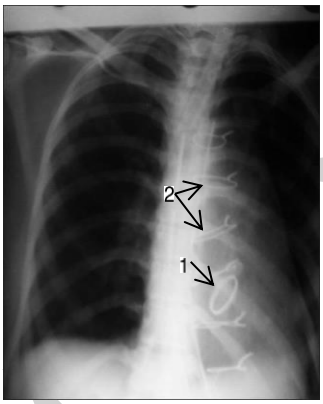
1. Rigid or fiber optic bronchoscope
2. C-arm fluoroscopy
3. Bronchotomy

CXR 7: Mitral valve prosthesis

Plain CXR PA view showing:

1: Ring of mitral valve prosthesis

2: Sutures of sternotomy

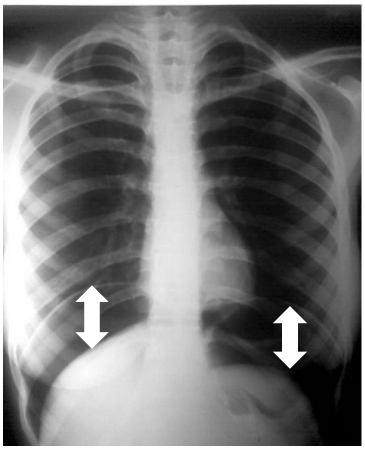


CXR 8: Air Under Diaphragm

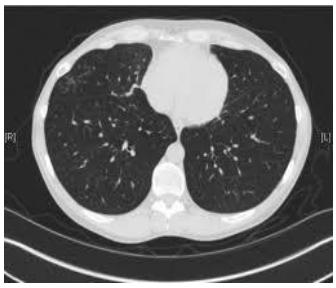
Most common cause: after laparotomy or laparoscopy

Other causes:

- Trauma/ perforation of the gut
- Pathological rupture:
  - Perforated PUD
  - Perforated typhoid ulcer
  - Perforated appendix
- Tubal insufflation in female



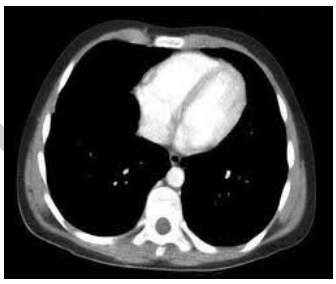
CT 1: Normal Chest



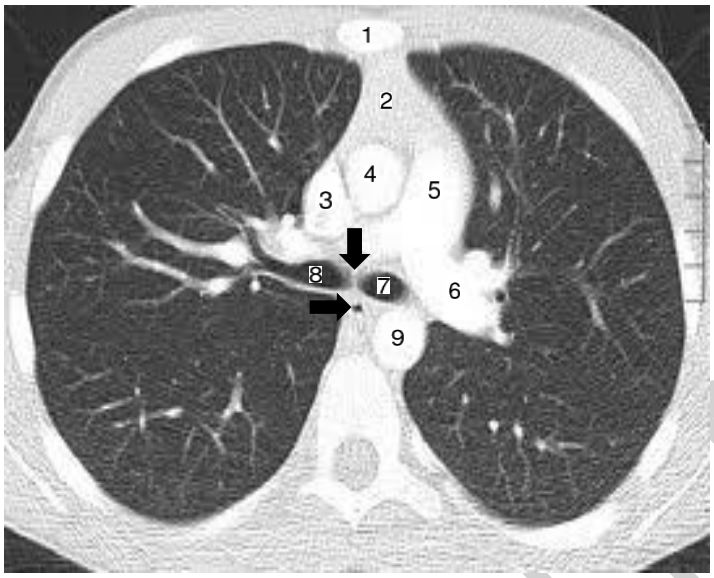
Note: Rt or Lt is like the CXR where the CT cut is taken from caudal to cranial (refer labeled CT pic for clarification)

2 windows:

1. Lung window: showing only lung details
2. Mediastinal window: showing only mediastinal details with jet black lungs



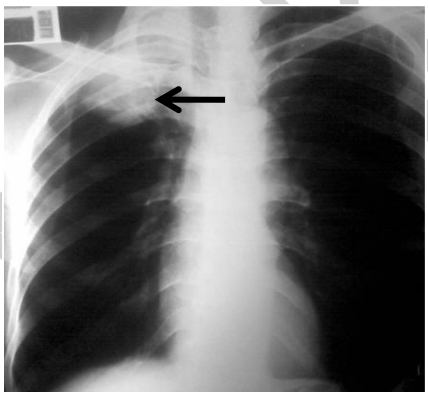
Note: lung window with IV contrast will have the mediastinum visible as seen in the labeled CT.



1: Sternum
2: Thymus gland
3: SVC
4: Ascending aorta
5: Pulmonary artery
6: Lt branch of pulmonary artery
7: Lt main bronchus
8: Rt main bronchus
9: Descending aorta

- Arrow pointing down: carina
- Arrow pointing Rt: rounded black dot = oesophagus

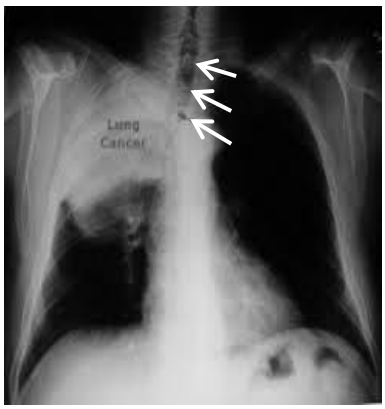
CXR 9: Lung Cancer – Pancoast tumour



Rt pancoast (superior sulcus) tumour
Notes:

- Apical in position
- If no 1st rib seen in Xray = pancoast (superior sulcus) syndrome

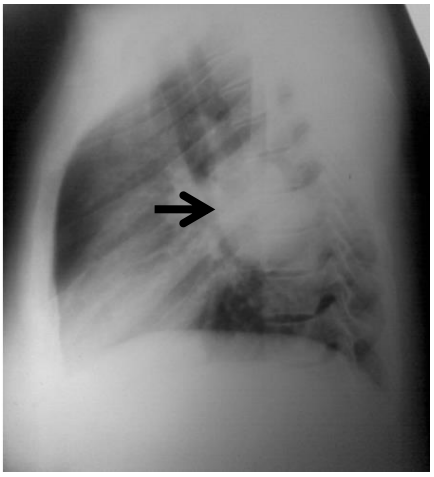
Pancoast syndrome = pancoast tumour + erosion of 1st and 2nd rib



Note:

Pancoast tumour **DOES NOT** cause hoarseness of voise as it doesn't cause any compression on the recurrent laryngeal nerve.

CXR 10: Lung Masses



Plain CXR lateral view showing central lung mass.

Differential diagnosis:

1. Benign: bronchial carcinoma
2. Malignant:
   - Small cell carcinoma
   - Squamous cell carcinoma
3. Carcinoid tumour

Plain CXR PA view showing Lt lung with central mass of irregular outline.

Most probable diagnosis:
Squamous cell carcinoma

Cause: Smoking

Other methods of investigation:

1. Sputum cytology
2. Biopsy via bronchoscopy

Peripheral mass in upper lung zone.

Differential diagnosis:

1. Adenocarcinoma
2. Large cell tumour

Next methods of investigations:

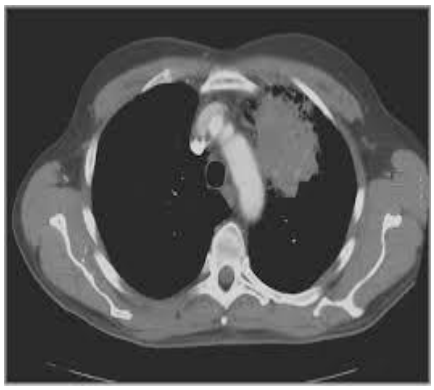
1. CT scan
2. CT guided percutaneous biopsy or VATS

Treatment: lobectomy

CT 2: Lung masses

CT mediastinal window showing large Rt lung mass or irregular border

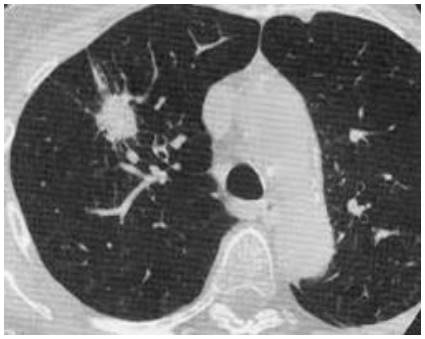
CT lung window showing Lt lung mass



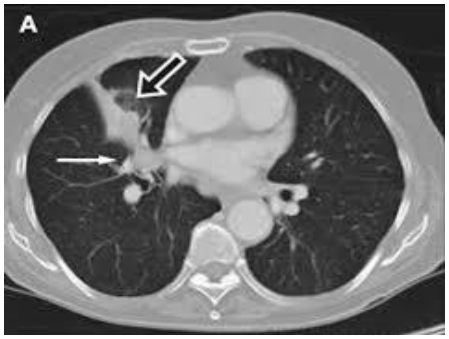
CT mediastinal window showing central Lt lung mass

Note: oblique line on the Rt side of the lesion is aortic arch.

CT lung window showing peripheral Lt lung mass



CT lung window showing Rt lung mass



CT lung window showing central Rt lung mass along with pleural tail (big black arrow)

Note: pleural tail = sure sign of malignancy

CXR 11: Lung Metastasis (very common)

Most common sources of lung metastases:

1. Renal cell carcinoma (hypernephroma) – causes cannon ball metastases
2. Sarcoma: soft tissue, osteogenic
3. Cancer breast
4. Colonic, liver carcinoma, etc.

Other differential diagnoses of this Xray:

1. Lung contusions
2. Multiple pyemic abscesses
3. Multiple hydatid cysts

In this patient, there is no surgery indicated.

Indications of surgery:

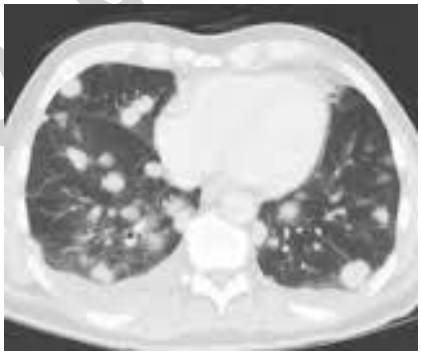
1. Controlled primary
2. No extrathoracic metastasis
3. Localized or small segment of the lung

Note: all surgeries of advanced tumours are only conservative surgeries

Difference between segmental and wedge resection (types of surgery):

Segmental is anatomical resection and obliteration of artery and vein whereas wedge is not anatomical.

CT 3: Lung Metastasis



CT lung window showing diffuse lung masses.

CXR 12: Lung Cysts

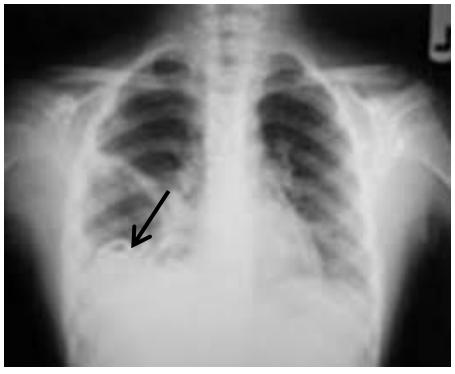
Types of lung cyst:

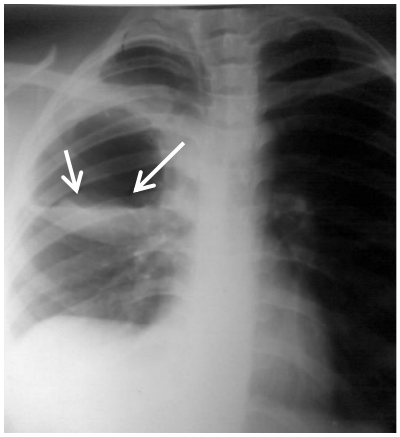
= air space i.e. bullae

= air fluid level i.e.

1. Localized lung abscess
2. Ruptured hydatid cyst
3. Encysted hydropneumothorax

= air cap sign i.e.





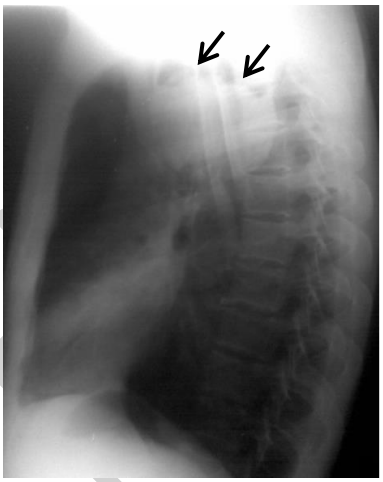
Plain CXR PA view showing hydatid cyst in lung – notice water lily sign (arrows)

Dr. Rutter

1. Tear in pseudocapsule with intact ecto and endo capsules
2. Old TB cavity with fungal vegetation = mycetoma

= **Water lily sign** – due to rupture of endocyst → pathognomonic for hydatid cyst

Hydatid cyst: formed of 3 layers:



External layer = pseudocapsule which is a fibro capsule formed by tissue compression

Middle layer = ectocyst (chitenous layer)

Innermost layer = living layer (forms the scolices and fluid)

Characteristic:

1. Well localized
2. Well circumscribed – thin smooth border (differentiate from lung abscess)

Best line of treatment = Enucleation and capetonage (i.e. purse-string action كشكشة – to close the dead space)

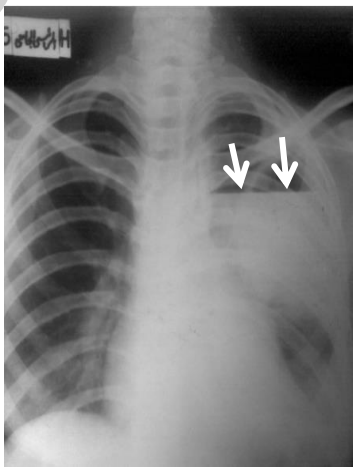
- Lung cancer that normally cavitates = Squamous cell carcinoma

Rt lower lobe lung abscess

Note: fluid level is low with thick walls and "spike" appearance (arrow) due to infiltration in nearby structures = malignant

CXR PA view showing air-fluid level into the cavity, (lung abscess)

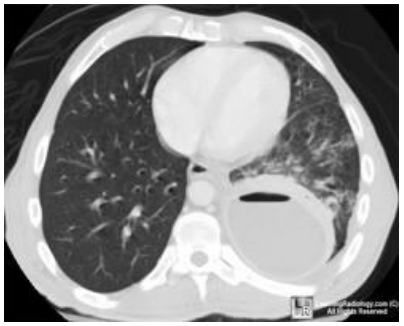
CXR lat. view showing air fluid level into the cavity (lung abscess)


Encysted hydropneumothorax of Lt side, notice the fluid level (arrows) and clear costophrenic angle

Note:

Could be lung abscess thus confirmed by CT whether it is parenchymatous or in pleural space

CT 4: Lung Abscess

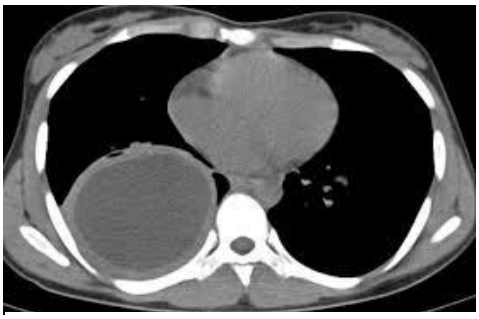


Criteria:

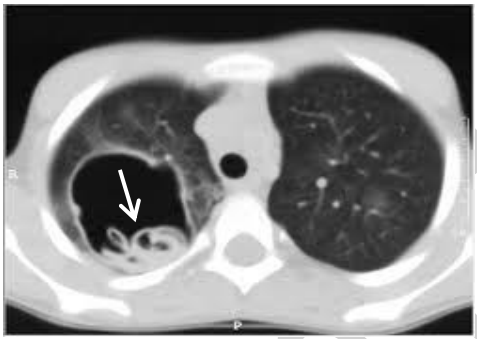
1. Thick wall
2. Air fluid level

Treatment: medical antibiotic for 3 months; if not resolved then indicated for surgery.

CT 5: Hydatid cyst



Mediastinal window showing thin smooth wall hydatid cyst – before rupture

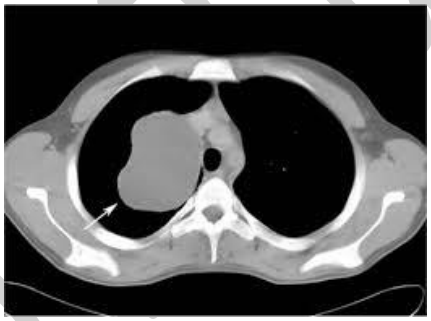


Lung window showing ruptured hydatid cyst with water lily sign (arrows)

CT 6: Bronchogenic Cyst (most common mediastinal cyst)

Criteria:

1. Smooth borders
2. Central (mediastinal) cyst [C/P = cough – due to airway compression]
3. Peripheral (parenchymal) cyst [C/P =recurrent infection]



CXR 13: Lung Bullae

Criteria:

1. Air filled space
2. Thin outlines
3. Small or large
4. Single or multiple

CT 7: Lung Bullae

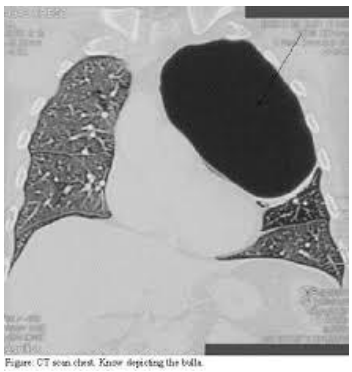
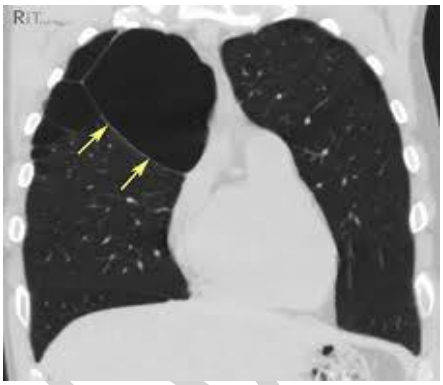


Figure: CT scan chest. Know depicting the bulla.

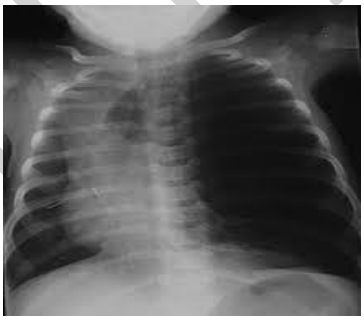


CT chest lung window showing Rt air cystic air spaces which are multiple and some are infected (lung abscess)

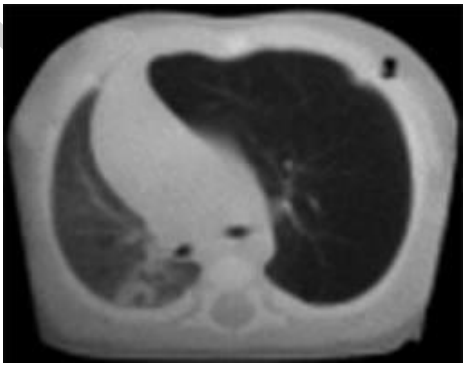
CXR 14: Congenital Lobar Emphysema

Criteria:

1. Congenital weakness of the cartilage
2. Compression of both lungs



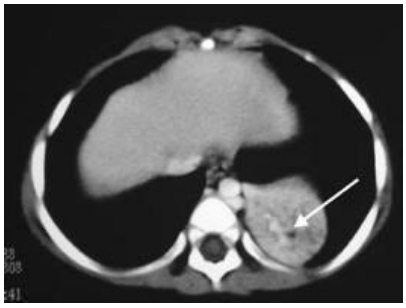
CT 8: Congenital Lobar Emphysema

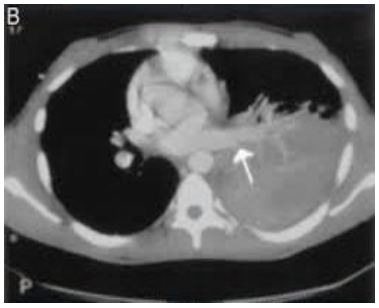


CT 9: Sequestrated Lobe

Criteria:

1. Nonfunctioning lung tissue not communicating with the airways
2. Receives blood supply from the aorta





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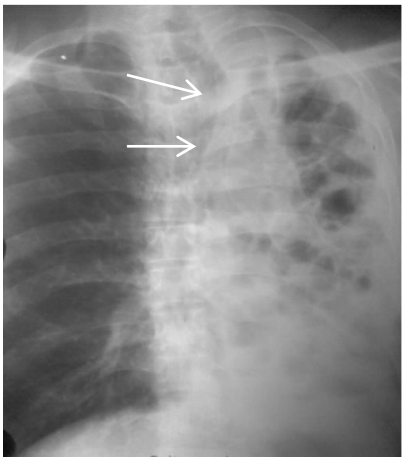
CXR 15: Bronchiectasis

Honey-comb appearance = cystic appearance

Indications for surgery:

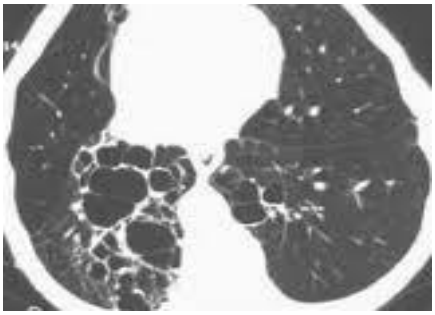
1. Localized
2. Massive/huge
3. Affects social life due to bad odour
4. Failure of treatment
5. Persistent infection e.g. TB

CXR showing Rt lower lobe bronchiectasis



Destroyed Lt lung, TB, notice tracheal shift to the diseased side

CT 10: Bronchiectasis (very important)



CT lung window showing Rt side cystic bronchiectasis

CXR 16: Mediastinal Mass

Mediastinal parts (mentioned page 2)

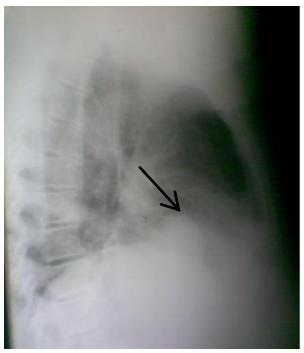
- Most common mediastinal mass = neurogenic tumour
- Most common middle mediastinal tumour = neurogenic tumour

*****Important notes*****

- Mediastinal inlet: lower border of C7 + 1st rib + upper sternomanubrium angle (angle of Lewis)
- Lower border (outlet): xiphoid process, lower border of T12
- Ant. wall = sternum
- Post. wall = verterbral column T1 – T12
- Middle = pericardial sac and its contents

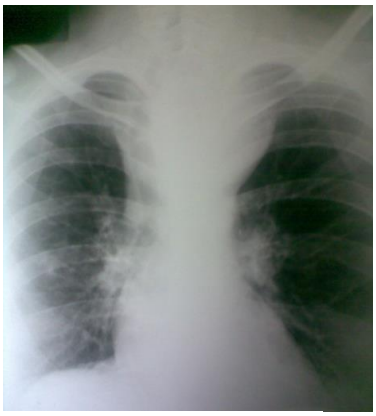
****Importance of angle of Lewis (level is at junction between T4 and T5)***

- Separates superior mediastinum from inferior
- Site of bifurcation of trachea (carina)
- Azygous venous drainage into SVC



Ant. mediastinal mass

Post. mediastinal mass



Sup. Mediastinal mass

Differential diagnosis:

1. Aortic arch aneurysm
2. Retrosternal goiter

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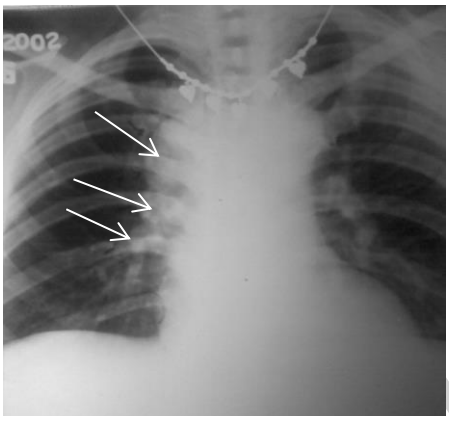
Causes of broad (wide) mediastinum:

1. Aortic aneurysm
2. Mediastinal abscess
3. Mega oesophagus
4. Mediastinal haematoma
5. Mediastinal tumours

Localized broadening of Mediastinum



Broadening of mediastinum by LN

Ant. mediastinal mass differential diagnosis: (4 T)

1. Thymoma (most common)
2. Teratoma
3. Thyroid (interthoracic goiter)
4. Lymphoma

CT 11: Mediastinal mass

CT chest mediastinal window showing post. mediastinal mass involving paravertebral line.

CXR 16: Normal Oesophagogram

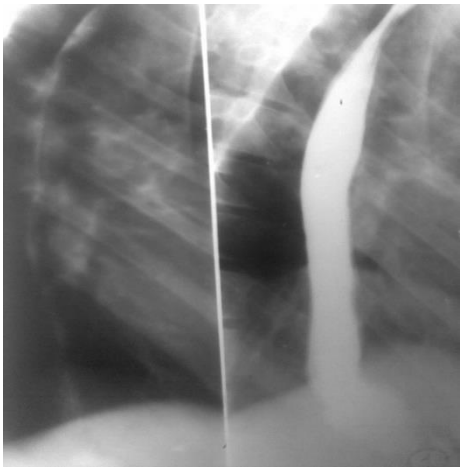
Includes barium swallow and shows:

1. Filling phase
2. Evacuation phase

Upper constriction indicates physiological narrowest part of oesophagus = cricopharyngeus

Followed by other sites of constriction of middle ⅓ of the oesophagus:

- Aortic arch
- Lt main bronchus



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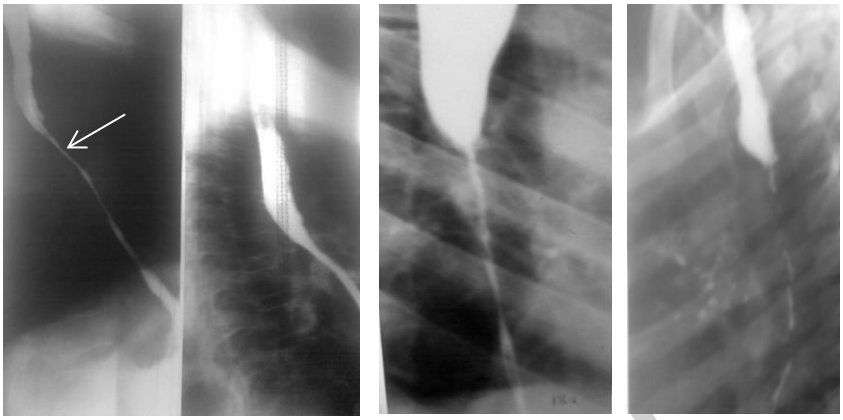
CXR 17: Oesophageal Stricture

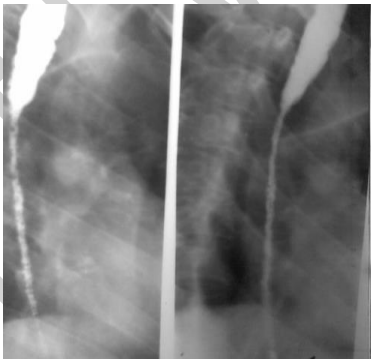


The following Xrays show benign oesophageal strictures that are post corrosive exposure.

Criteria:

- Smooth long segment stricture
- **NO** irregularity + absent shoulder sign

Treatment: retrograde dilatation via gastrostomy



These Xrays are NOT achalasia as they don't fulfill the criteria of achalasia; which are:

1. Dilatation
2. Tapering at lower end of oesophagus
3. At oesophago-diaphragmatic opening
4. Ground-glass appearance filling defect

- **Difference between Barium meal and Barium swallow:**
  - Barium swallow is a paste like substance that is used for diagnosis of oesophageal lesions.
  - Barium meal is a fluid like substance that is used for diagnosis of stomach lesions (Note: patient is made to sleep with his head at a position lower than his legs so that the barium swallow would show if there are any filling defects in the fundus)

CXR 18: Cancer Oesophagus

Notice the filling defect and the irregularity of the oesophageal wall.

Normal cervical oesophagus

Cancer lower ⅓ oesophagus
Arrow pointing at shouldering sign

Treatment by 3 approaches mainly:

1. Transabdominal Lt thoracotomy (laparotomy)
2. Lt thoracoabdominal incision
3. Lt thoracotomy transdiaphragmatic

Other approach: blind oesophagectomy

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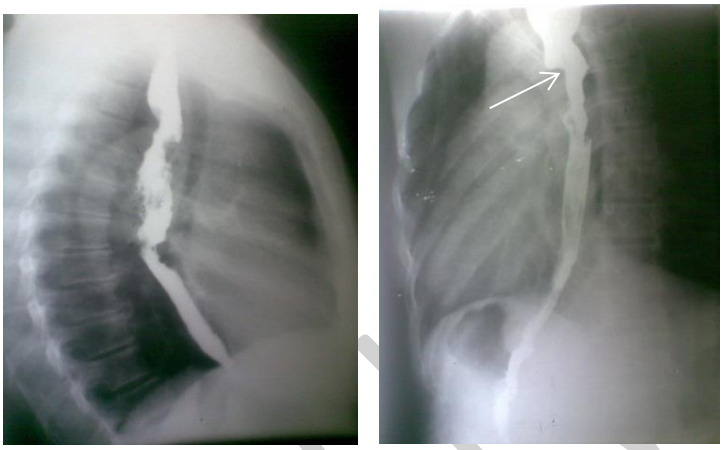
Cancer fundus and cardia

Large part of fundus is affected and a small part of oesophagus is affected. Thus this tumour is an adenocarcinoma.

(If the affection is vice versa then the lesion is most



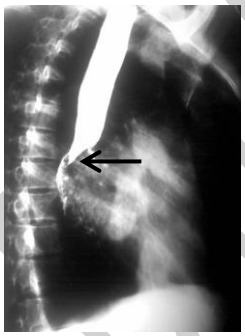
Barium swallow lat. view showing cancer middle ⅓ oesophagus, notice shouldering sign (arrow)

Type of tumour: squamous cell carcinoma

Note: to determine the age of the patient whether young or old – look at the vertebrae ossification. Thus the Lt Xray is for an old patient.

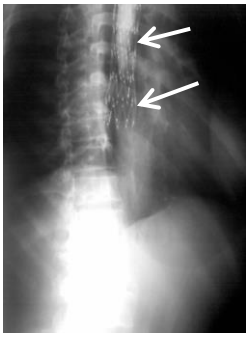
Treatment: abdominal blind thoracotomy

CXR 19: Oesophageal Compression



External compression on oesophagus (arrow)

CXR 20: Oesophageal Stent



Self-expandable metallic stent = best palliative treatment

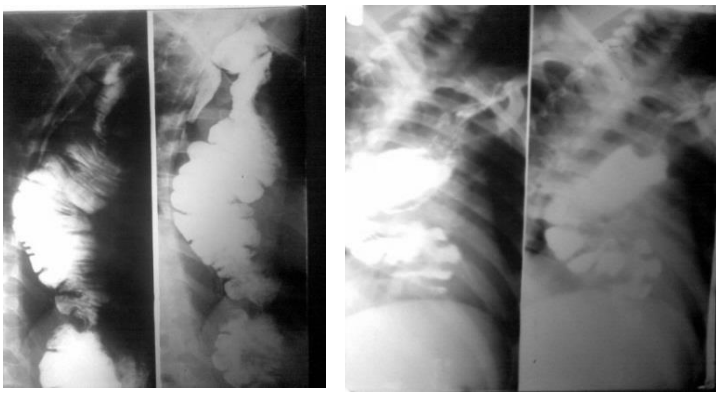
Used in advanced stage of oesophageal carcinoma.

CXR 21: Colonic Interposition

Barium swallow showing colon in the mediastinal region.

Indications for colonic interposition surgery:

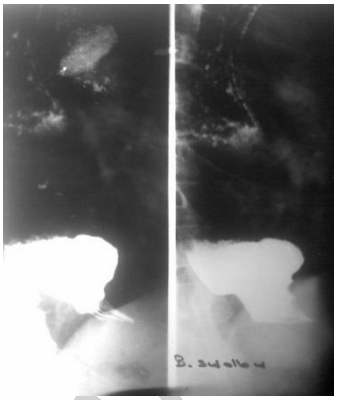
1. Mega oesophagus in advanced achalasia
2. Cancer oesophagus that is inoperable thus requires bypass surgery
3. Cancer oesophagus that is operable and this is its resection
4. Post corrosive stricture

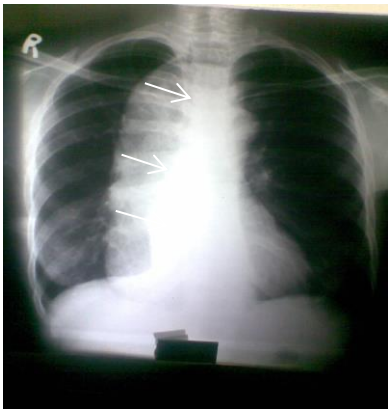


CXR 22: Achalasia of Cardia (Bird's beak appearance)

Typical form of achalasia of the cardia showing:

1. Dilatation of the oesophagus
2. Tapering lower end of the oesophagus to the oesophago-diaphragmatic opening
3. Ground-glass appearance at the top due to presence of food and fluid





CXR with broadened mediastinum (advanced achalasia)

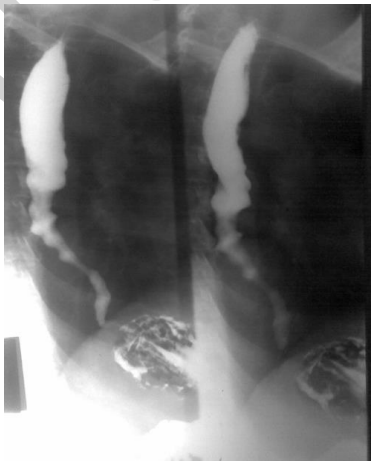
Treatment: colonic interposition

Barium swallow showing advanced achalasia of the Lt pic.

Advanced achalasia of the cardia Rt pic showing sigmoid pattern

CXR 23: Diffuse Oesophageal Spasm (cork-screw appearance)

Cause: exposure to corrosive intake



CXR 24: Oesophageal Diverticulae

- Upper and lower ⅓'s of the oesophagus have **FALSE** diverticulae as only the mucosa is distended due to **PULSION**.
- Middle ⅓ of oesophagus has **TRUE** diverticulum as both mucosa and musculosa are distended due to **TRACTION**.
- **C/P:** severe dysphagia
- Upper oesophagus diverticulum = Zenker's diverticulum
- Lower oesophagus diverticulum = Lower epiphrenic diverticulum

Small Zenker's diverticulum

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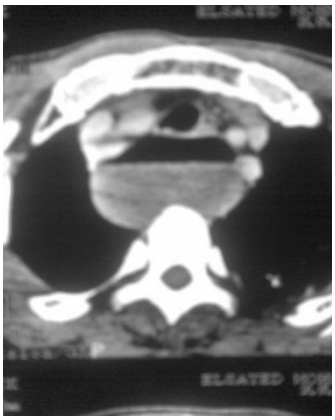
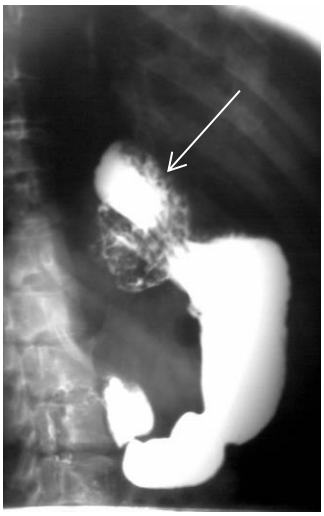
Huge Zenker's diverticulum

Large epiphrenic diverticulum

CT 12: Huge Zenker's Diverticulum



CXR 25: Hiatal Hernia

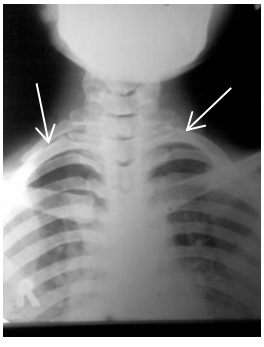


Barium meal showing hiatal hernia of the stomach (hour-glass stomach appearance)

Types of hiatal hernia (based on cardia position):

- Type I: sliding
- Type 2: paraoesophageal
- Type 3: both sliding and paraoesophageal (mixed)
- Type 4: complex type + colon position

CXR 26: Cervical rib



Normal CXR showing extra ribs in the cervical region.

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